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(54) INK JET RECORDING APPARATUS AND CONTROL METHOD THEREFOR

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(57) **ABSTRACT**

The invention is to provide a user-friendly ink jet recording apparatus capable of preventing a sudden ink exhaustion and a resulting unclear print by canceling the no-ink error signal without an ink tank replacement. In the ink jet recording apparatus, in case of a no-ink error signal, a no-ink timer is activated and time information of no-ink state is stored in a non-volatile memory, and a period from such-time is measured and compared, and after the lapse of predetermined time, a no-ink error signal is generated even before a threshold value for the no-ink error signal is reached, thereby requesting an ink tank replacement to the user.

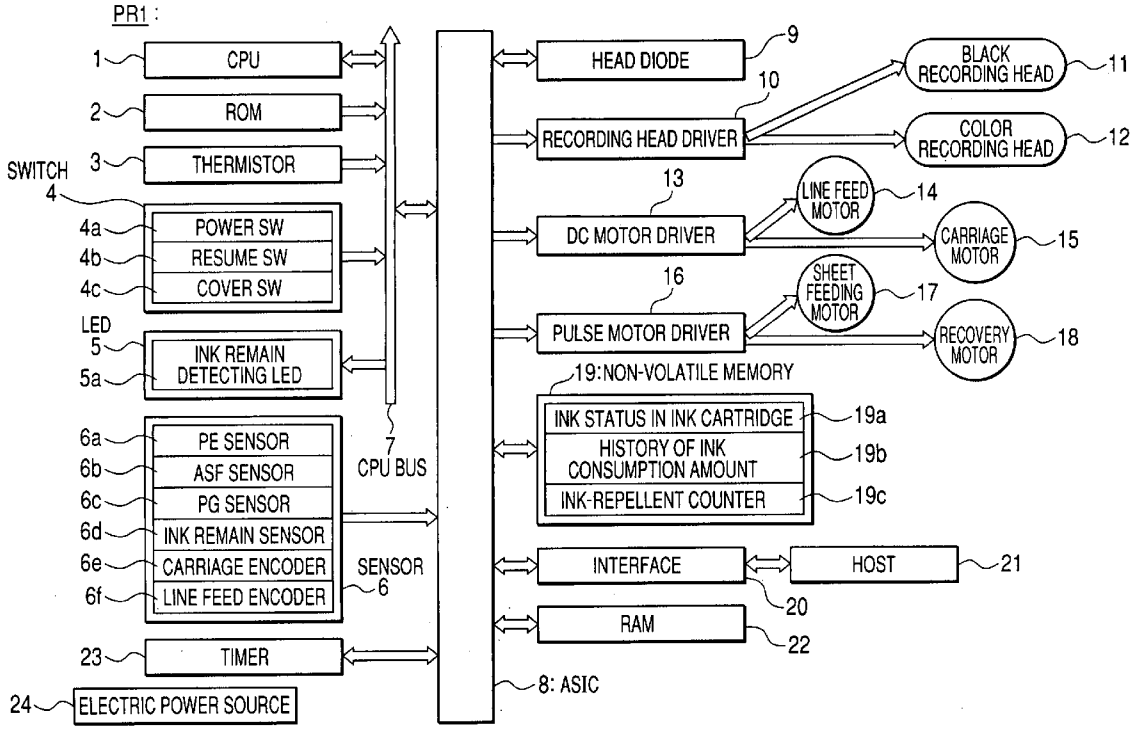
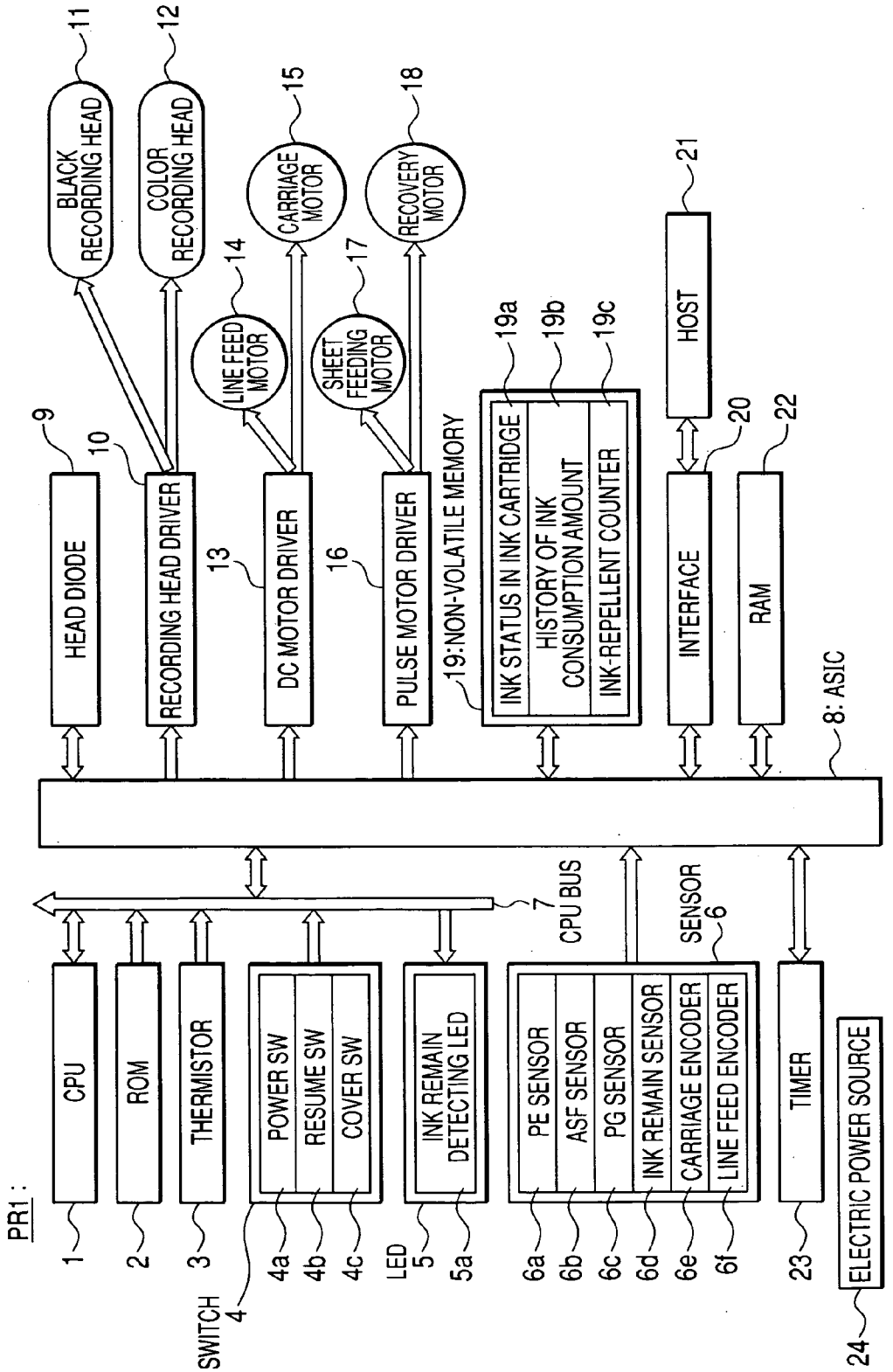


FIG. 1


PR1 :
CPU
ROM
THERMISTOR
POWER SW
RESUME SW
COVER SW
INK REMAIN DETECTING LED
PE SENSOR
ASF SENSOR
PG SENSOR
INK REMAIN SENSOR
CARRIAGE ENCODER
LINE FEED ENCODER
TIMER
ELECTRIC POWER SOURCE
SWITCH
LED
SENSOR
CPU BUS
HEAD DIODE
RECORDING HEAD DRIVER
DC MOTOR DRIVER
PULSE MOTOR DRIVER
19:NON-VOLATILE MEMORY
INK STATUS IN INK CARTRIDGE
HISTORY OF INK CONSUMPTION AMOUNT
INK-REPELLENT COUNTER
INTERFACE
RAM
8: ASIC
BLACK RECORDING HEAD
COLOR RECORDING HEAD
LINE FEED MOTOR
CARRIAGE MOTOR
SHEET FEEDING MOTOR
RECOVERY MOTOR
HOST
1
2
3
4
4a
4b
4c
5
5a
6
6a
6b
6c
6d
6e
6f
7
8
9
10
11
12
13
14
15
16
17
18
19a
19b
19c
20
21
22
23
24

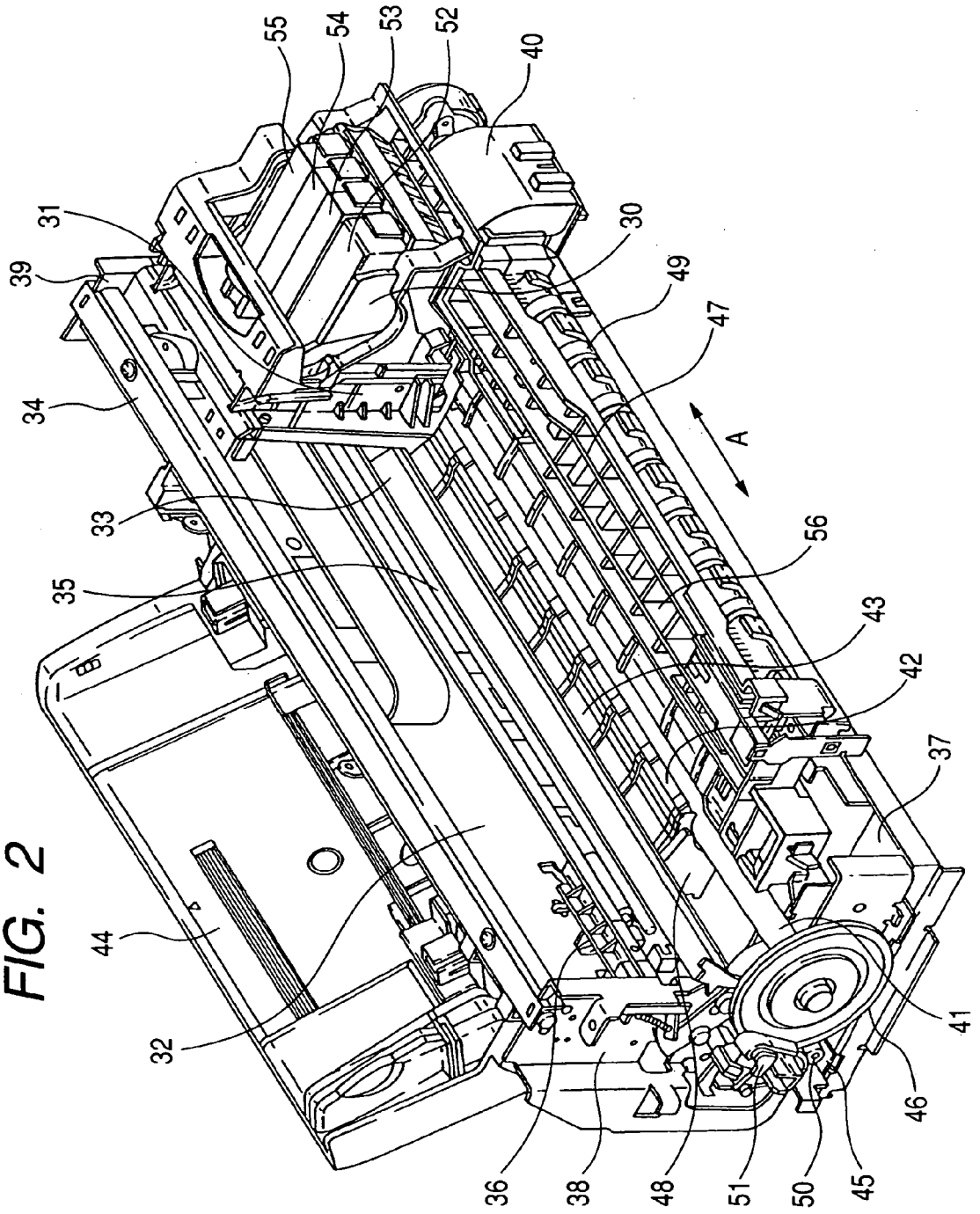

55
54
53
52
40
31
39
30
49
47
34
A
33
56
35
43
42
37
44
41
32
46
36
38
48
51
50
45

FIG. 2

FIG. 3

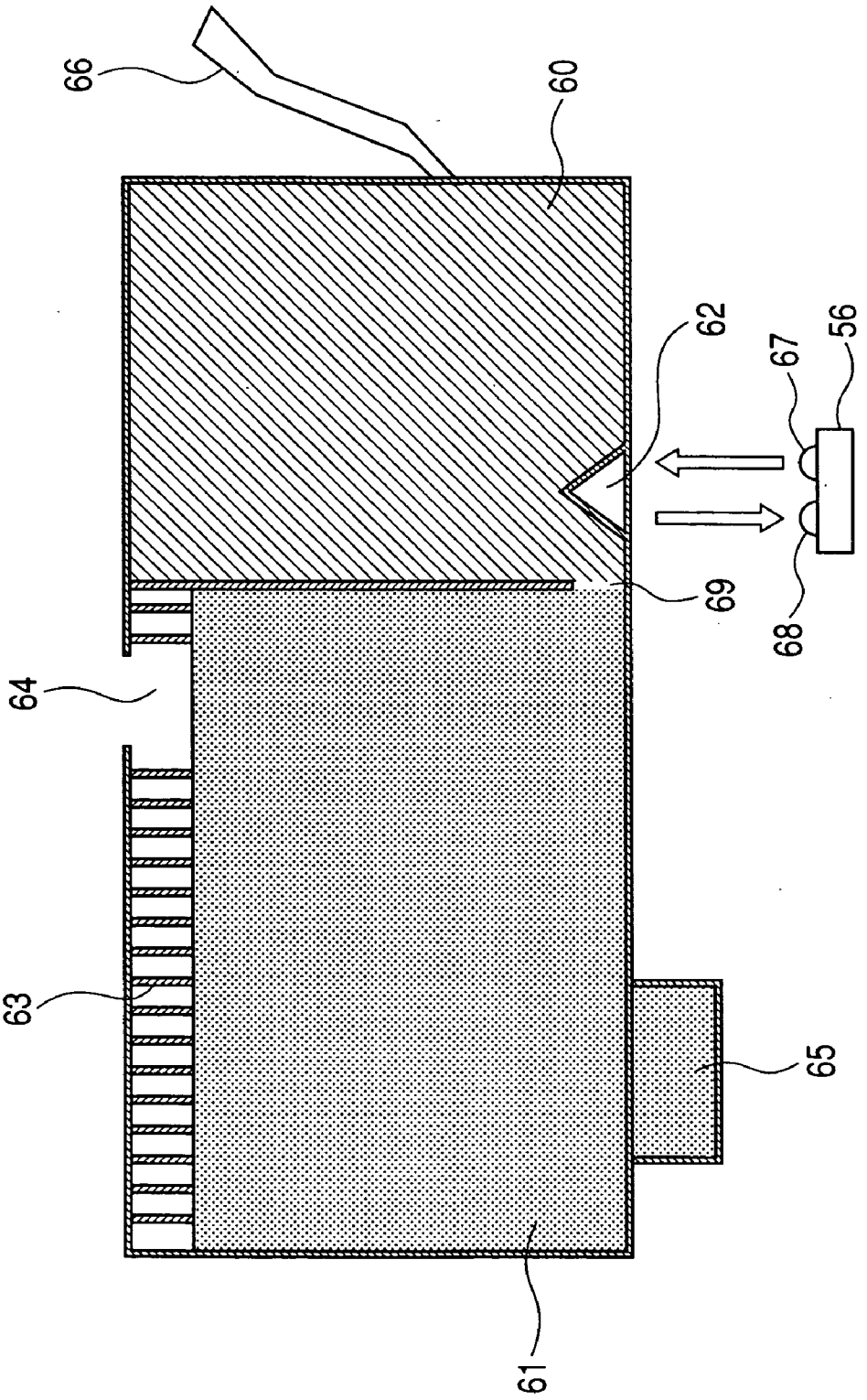


FIG. 4

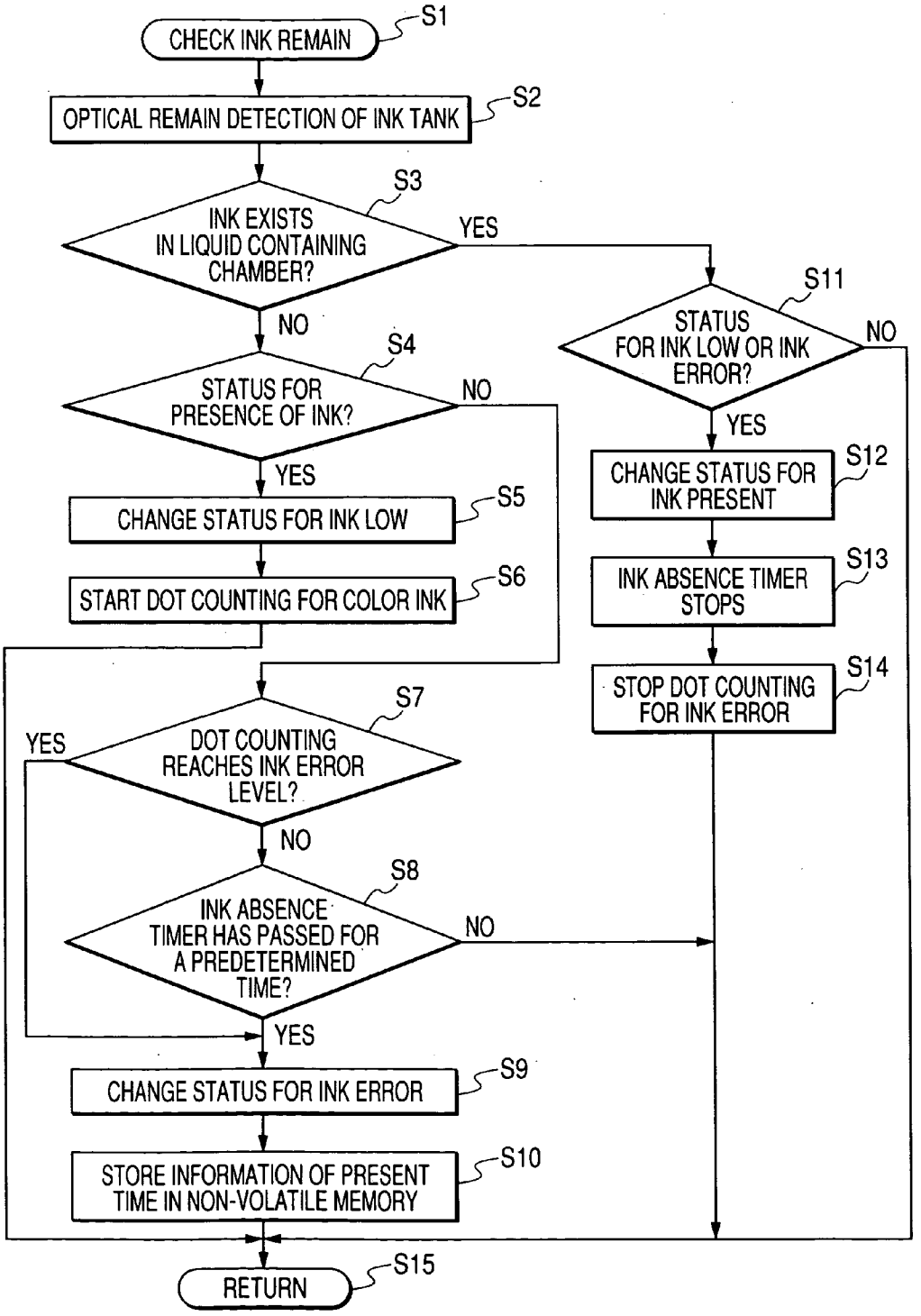

CHECK INK REMAIN
S1
OPTICAL REMAIN DETECTION OF INK TANK
S2
INK EXISTS IN LIQUID CONTAINING CHAMBER?
S3
YES
NO
STATUS FOR PRESENCE OF INK?
S4
NO
YES
CHANGE STATUS FOR INK LOW
S5
START DOT COUNTING FOR COLOR INK
S6
DOT COUNTING REACHES INK ERROR LEVEL?
S7
YES
NO
INK ABSENCE TIMER HAS PASSED FOR A PREDETERMINED TIME?
S8
NO
YES
CHANGE STATUS FOR INK ERROR
S9
STORE INFORMATION OF PRESENT TIME IN NON-VOLATILE MEMORY
S10
RETURN
S15
STATUS FOR INK LOW OR INK ERROR?
S11
NO
YES
CHANGE STATUS FOR INK PRESENT
S12
INK ABSENCE TIMER STOPS
S13
STOP DOT COUNTING FOR INK ERROR
S14

FIG. 5

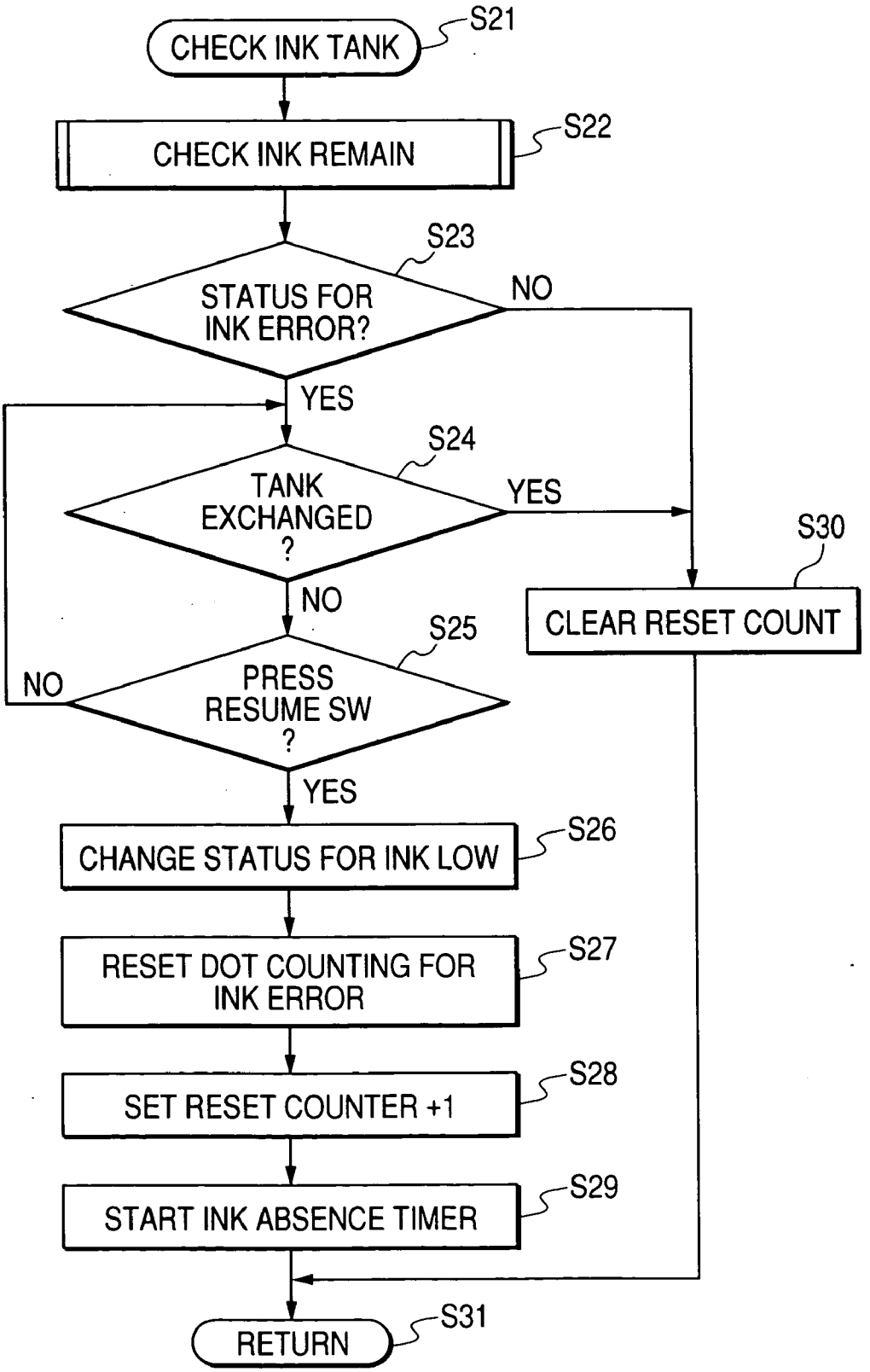

CHECK INK TANK
S21
CHECK INK REMAIN
S22
S23
STATUS FOR INK ERROR?
NO
YES
S24
TANK EXCHANGED ?
YES
NO
S25
PRESS RESUME SW ?
NO
YES
S30
CLEAR RESET COUNT
CHANGE STATUS FOR INK LOW
S26
RESET DOT COUNTING FOR INK ERROR
S27
SET RESET COUNTER +1
S28
START INK ABSENCE TIMER
S29
RETURN
S31

FIG. 6

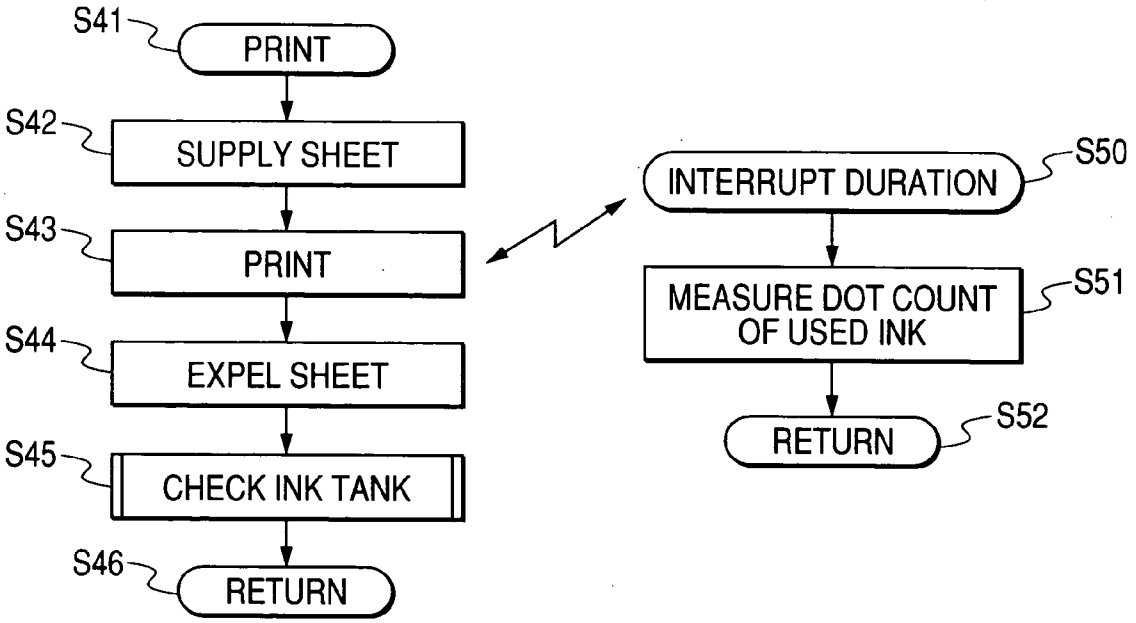

S41
PRINT
S42
SUPPLY SHEET
S43
PRINT
S44
EXPEL SHEET
S45
CHECK INK TANK
S46
RETURN
INTERRUPT DURATION
S50
MEASURE DOT COUNT OF USED INK
S51
RETURN
S52

FIG. 7

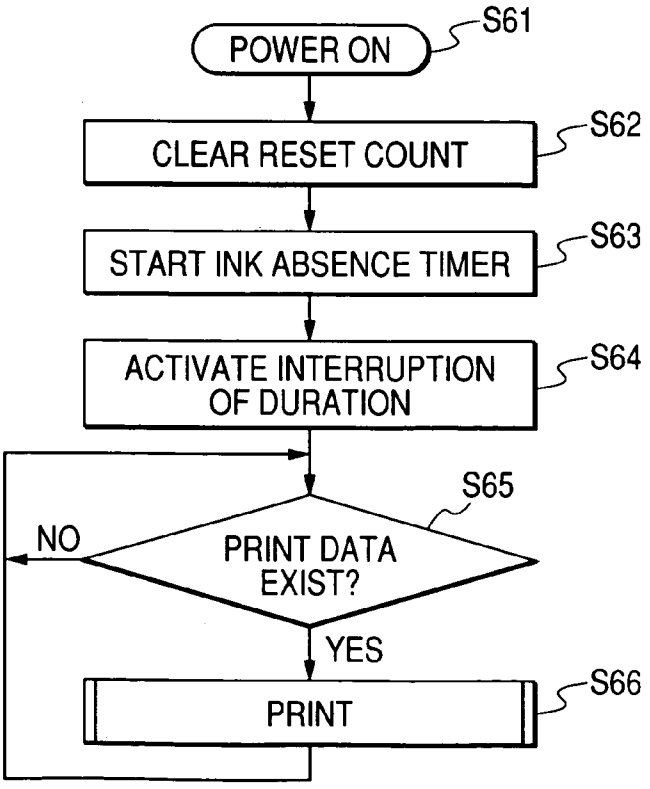
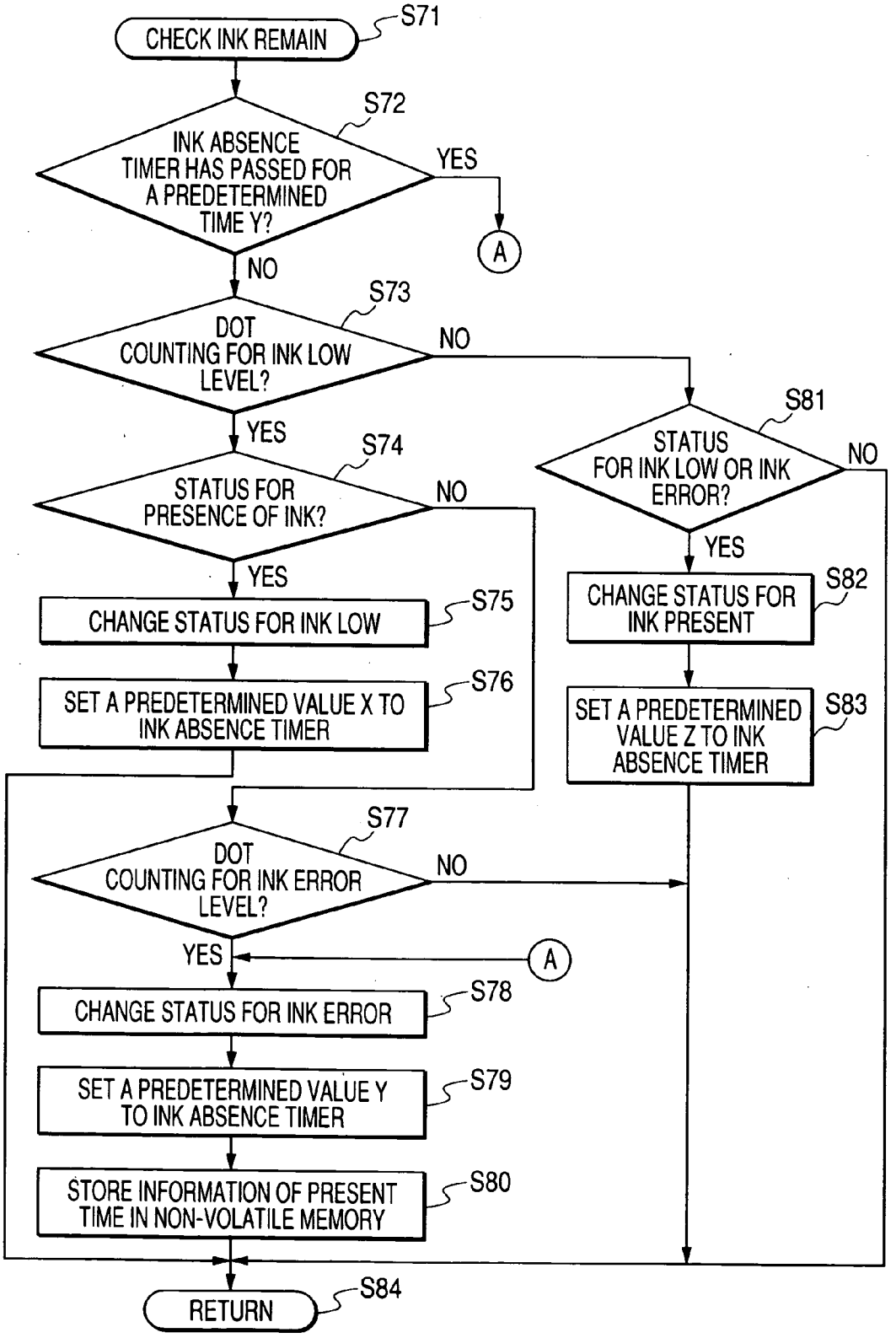

POWER ON
S61
CLEAR RESET COUNT
S62
START INK ABSENCE TIMER
S63
ACTIVATE INTERRUPTION OF DURATION
S64
S65
NO
PRINT DATA EXIST?
YES
PRINT
S66

FIG. 8


CHECK INK REMAIN
S71
INK ABSENCE TIMER HAS PASSED FOR A PREDETERMINED TIME Y?
S72
YES
A
NO
DOT COUNTING FOR INK LOW LEVEL?
S73
NO
YES
STATUS FOR PRESENCE OF INK?
S74
NO
YES
CHANGE STATUS FOR INK LOW
S75
SET A PREDETERMINED VALUE X TO INK ABSENCE TIMER
S76
STATUS FOR INK LOW OR INK ERROR?
S81
NO
YES
CHANGE STATUS FOR INK PRESENT
S82
SET A PREDETERMINED VALUE Z TO INK ABSENCE TIMER
S83
DOT COUNTING FOR INK ERROR LEVEL?
S77
NO
YES
A
CHANGE STATUS FOR INK ERROR
S78
SET A PREDETERMINED VALUE Y TO INK ABSENCE TIMER
S79
STORE INFORMATION OF PRESENT TIME IN NON-VOLATILE MEMORY
S80
RETURN
S84

INK JET RECORDING APPARATUS AND CONTROL METHOD THEREFOR

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an ink jet recording method and a control method therefor.

[0003] 2. Related Background Art

[0004] In the prior art, a no-ink error signal in an ink jet recording apparatus is cancelled by an ink tank replacement, and, in case a same ink tank is used in continuation without the ink tank replacement, such no-ink error signal can be cancelled by an operation of a resume key or the like.

[0005] In case the no-ink error signal is cancelled by the resume key operation, a no-ink error signal of second time is generated with a threshold value same as that in the first-no-ink error signal.

[0006] There is also proposed a method of changing the threshold value to ½ and to ¼ in the second time and thereafter.

SUMMARY OF THE INVENTION

[0007] In such prior configuration, a user with a low frequency of use of the printer may forget that the no-ink error signal has been cancelled without replacing the ink tank. In case of use by plural users in a home, a next user does not know such history on the no-ink error signal. Therefore the user may encounter a situation where the ink is exhausted and the print becomes unclear without the no-ink error signal.

[0008] An object of the present invention is to provide a user-friendly ink jet recording apparatus capable of preventing a sudden ink exhaustion and a resulting unclear print by canceling the no-ink error signal without an ink tank replacement.

[0009] According to the present invention, when a no-ink state is reached, a no-ink timer is activated and time information when the no-ink state is reached is stored in a non-volatile memory. Then a lapse of a predetermined time is measured from the timing of storage of the time information, and, after the laps of the predetermined time, an ink tank replacement is requested to the user even before a threshold value for the no-ink error signal is reached.

[0010] The present invention provides an effect of preventing a situation where the ink is abruptly exhausted to result in an unclear printing by canceling a no-ink error signal without an ink tank replacement.

[0011] In particular, in case a user who has cancelled a no-ink error signal had not executed an ink tank replacement, a no-ink situation can be immediately informed when another user uses a printer after the lapse of a long period.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is a block diagram showing an ink jet recording apparatus PR1 constituting a first embodiment of the present invention;

[0013] **FIG. 2** is a perspective view, seen from a left side, of the entire ink jet recording apparatus PR1;

[0014] **FIG. 3** is a cross-sectional view showing ink tanks **52**, **53**, **54**, **55**;

[0015] **FIG. 4** is a flow chart showing an ink remain checking operation of the ink jet recording apparatus PR1;

[0016] **FIG. 5** is a flow chart showing an ink tank checking operation of the ink jet recording apparatus PR1;

[0017] **FIG. 6** is a flow chart showing a printing operation in the ink jet recording apparatus PR1;

[0018] **FIG. 7** is a flow chart showing a power-on operation in the ink jet recording apparatus. PR1; and

[0019] **FIG. 8** is a flow chart showing an ink remain checking operation II in a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] The present invention can be best realized by following embodiments.

First Embodiment

[0021] **FIG. 1** is a block diagram showing an ink jet recording apparatus PR1 constituting a first embodiment of the present invention.

[0022] The ink jet recording apparatus PR1 is equipped with a CPU **1**, a ROM **2**, a switch **4**, an LED **5**, various sensors **6**, a CPU bus **7**, an ASIC **8**, a recording head driver **10**, k a black recording head **11**, a color recording head **12**, a DC motor driver **13**, a line feed motor **14**, a carriage motor **15**, a stepping motor driver **16**, a recovery motor **18**, a non-volatile memory **19**, an interface **20**, a host computer **21**, a RAM **22**, a timer **23**, a power source **24**, a carriage **30** and a conveying roller **33**.

[0023] The CPU **1** is a central processing unit constituted for example of a programmable microprocessor.

[0024] The ROM **2** stores font data, program instruction sequences to be executed by the CPU **1** for controlling the ink jet recording apparatus PR1, and various control tables.

[0025] The switch **4** includes switches to be operated by the user, such as a power switch **4***a* and a resume switch **4***b*.

[0026] The sensors **6** include a PE sensor (paper end sensor) **6***a*, an ASF sensor (sheet feeding sensor) **6***b*, a PG sensor (purge sensor) **6***c*, an ink remain sensor **6***d*, an encoder **6***e* and an encoder **6***f*.

[0027] The non-volatile memory **19** stores printer information such as an ink status **19***a* in an ink cartridge, an ink consumption history **19***b*, a used ink counter **19***c* etc.

[0028] The RAM **22** stores, during an execution of a program stored in the ROM **2** by the CPU **1**, various recording data transferred from the host computer **21** through an interface **20** in a print buffer in the RAM **22**, in order to achieve a print output by the black recording head **11** and the color recording head **12**.

[0029] The ASIC **8** is a control logic circuit which controls the recording head driver **10** in order to output control signals for nozzles in the recording heads **11**, **12**, also controls data transfer among the interface **20**, the CPU **1** and

the RAM **22**, and is further provided with control logic circuits for the DC motor driver **13** and the stepping motor driver **16**.

[**0030**] The CPU **1** is connected to the CPU bus **7**. The interface **20** is provided with a signal path capable of bi-directional signal exchange between the ink jet recording apparatus PR**1** and the host computer **21**, and receives recording data and commands from the host computer **21**.

[**0031**] The DC motor driver **13** controls the line feed motor **14** and the carriage motor **15**. The line feed (LF) motor **14** drives the conveying roller **33**, thereby controlling conveying and feed-discharge of a sheet. The carriage motor **15** drives a carriage **30** thereby controlling displacements of the recording heads **11**, **12** to a recording position on a scanning row.

[**0032**] The stepping motor driver **16** controls the sheet feed motor **17** and the recovery motor **18**. The sheet feed motor **17** controls a sheet pickup operation at a sheet feeding operation. The recovery motor **18** controls recovery operations such as a cleaning, a wiping, a capping etc. for the recording heads **11**, **12**.

[**0033**] The black recording head **11** and the color recording head **12**, controlled by the recording head driver **10**, are removable units displaced by the carriage. Such heads **11**, **12** include an ink discharge nozzle for forming a recorded image on a recording medium, and a head diode **9** for feeding back information on the presence and characteristics of the removable recording head.

[**0034**] Based on an electrical signal transferred from the recording head driver **10**, an electrothermal converting element of the recording head **11** or **12** is driven to generate thermal energy for causing a film boiling in the ink. As an ink discharge amount varies by a temperature of the recording head **11** or **12**, a thermistor **3** for measuring an ambient temperature of the ink jet recording apparatus PR**1** monitors a temperature output from the head diode **9** of the recording head **11**, **12**.

[**0035**] Various sensors **6** are mounted on the ink jet recording apparatus PR**1**. A PE sensor (pager end sensor) detects a passing sheet. An ASF sensor (sheet feed sensor) **6***b* detects a rotational position of a cam in a sheet feeding unit.

[**0036**] A PG sensor (purge sensor) **6***c* detects a cam position of a head recovery unit. An ink remain detecting sensor **6***d* is an optical sensor which detects presence/absence of ink in an ink tank, by an optical transmittance when the ink tank, supported on the carriage **30**, passes over the sensor by a displacement of the carriage **30**. In addition, there are also included a cover sensor linked with a cover switch **4***c*, an encoder **6***e* for reading positional information of the carriage, and an encoder **6***f* for reading positional information of the line feed (LF) motor.

[**0037**] There are also provided switches to be operated by the user, such as a power switch **4***a*, a resume switch **4***b* etc. Also there is provided a display LED **5** for informing the user with a status of the ink jet recording apparatus PR**1**. An LED **5***a* is a light-emitting element used for detecting an ink remaining amount. The timer **23** is involved in controlling the motors, and the power source **24** supplies an electric power for driving the ink jet recording apparatus PR**1**.

[**0038**] **FIG. 2** is a perspective view of the entire ink jet recording apparatus PR**1**, seen from left side.

[**0039**] The ink jet recording apparatus PR**1** is equipped with a recording head **30**, a carriage **31**, a chassis **32**, a guide shaft **33**, a guide rail **34**, a timing belt **35**, a carriage encoder **36**, a base chassis **37**, a left side plate **38**, a right side plate **39**, a recovery unit **40**, a conveying roller **41**, a pinch roller **42**, a pinch roller holder **43**, an automatic sheet feeder **44**, a line feed encoder **46**, a first sheet guide member **48**, a position detector **51**, sheet discharge rollers **49**, a black ink tank **52**, a cyan ink tank **53**, a magenta ink tank **54**, and a yellow ink tank **55**.

[**0040**] The recording head **30** constitutes image recording means. The carriage **31** constitutes head mounting means for mounting the recording head **30**. The guide shaft **33** serves as a guide member for guiding the carriage **31** in a direction A in **FIG. 2**, and also as a support means for supporting the carriage **31**. A right hand side of the guide shaft **33** is positioned and fixed on the right side plate **39**, and a left hand side of the guide shaft **33** is positioned and fixed on the left side plate **38**.

[**0041**] The guide rail **34** is another guide/support member for guiding the carriage **31**, thereby guiding the displacement thereof. A right hand side of the guide rail **34** is positioned on the right side plate **39**, and a left hand side of the guide rail **34** is positioned on the left side plate **38**.

[**0042**] A part of the timing belt **35** is fixed to the carriage **31**. The carriage motor is positioned and fixed on the chassis **32**. A drive of the carriage motor allows to causing a scanning motion of the carriage **31**, supporting the recording head **30**, in a direction A in **FIG. 2**.

[**0043**] The carriage encoder **36** is a scale indicating an absolute position of the carriage **31** in the scanning direction, and constitutes position detecting means. A light hand side of the carriage encoder **36** is positioned and fixed on the right side plate **39**, and a position of the carriage encoder **36** in height is restricted by the left side plate **38**.

[**0044**] The recovery unit **40** executes a discharge recovery operation of the recording head **30**. It includes an unillustrated cleaning means for cleaning a head face of the recording head **30**, and an unillustrated cap means for forming a closed system on a discharge port portion of the recording head **30**, and is positioned and fixed on the base chasses **37**.

[**0045**] The conveying roller **41** is a sheet conveying rotary member (conveying means) for conveying a recording sheet as a recording medium. The pinch roller **42** maintains, by an unillustrated spring, the recording sheet in contact with the conveying roller **41**. The pinch roller holder **43** rotatably supports the pinch roller **42**.

[**0046**] The line feed encoder **46** is a scale for detecting a rotational position of the conveying roller **41**, and is mounted on an end portion of the conveying roller **41**. The position detector **51** is fixed on the left side plate **38**, and detects a rotation amount of the conveying roller **41**. The sheet discharge rollers **49** discharge the recording sheet to the exterior of the ink jet recording apparatus PR**1**.

[**0047**] The automatic sheet feeder **44** supports a stack of plural recording sheets, and separates and feeds a sheet at a time. The recording sheet fed by the automatic sheet feeder

44 is guided by the pinch roller holder **43** and the first sheet guide member **48**, and is conveyed to a nip portion of the conveying roller **41** and the pinch roller **42**. The first sheet guide member **48** is positioned and fixed, like the second sheet guide member, on the positioning portion of the base chassis **37**.

[**0048**] The black ink tank **52**, the cyan ink tank **53**, the magenta ink tank **54** and the yellow ink tank **55** are mounted on the recording head **30**, detachably from the recording head **30**, and constitute ink reservoirs for discharging inks, designated by the host, onto the recording sheet.

[**0049**] **FIG. 3** is a cross-sectional view showing the inks tank **52**, **53**, **54** or **55**.

[**0050**] The ink tank **52**, **53**, **54** or **55** or each color is provided, on an outside thereof, with an integral lever member **66** elastically deformably. Each color ink tank **52**, **53**, **54** or **55** communicates with the air in an upper part through a communicating aperture **64**, and with an ink supply aperture **65** in a lower part, and includes therein a chamber **61** containing an absorbent member constituting a negative pressure generating member, and a substantially enclosed liquid chamber **60** for containing a liquid ink. The chambers **60** and **61** are separated by a partition.

[**0051**] The first chamber **60** and the second chamber **61** mutually communicates only through a communicating aperture **69** formed in the partition in the vicinity of the bottom of the ink tank. On an upper wall defining the first chamber **60**, plural ribs **63** protruding inwardly are formed integrally. The absorbent member in the first chamber **61** is formed by a thermally compressed urethane foam, and is contained in a compressed state in order to generate a predetermined capillary force.

[**0052**] The ink remain detecting sensor unit **56** is provided with a light-emitting element **67** emitting an infrared light, and a photosensor element **68** capable of receiving the light from the light-emitting element **67**. In each color ink tank, a light-reflecting prism **62** is provided integrally with the ink tank and is formed by an almost transparent material such as polypropylene. In the absence of ink on inclined top faces of the prism, the light from the light-emitting element **67** can be reflected and can reach the photosensor element **68**. In a state where the ink is filled around the inclined top faces of the prism, the light from the light-emitting element **67** is less reflected to reduce the light amount reaching the photosensor element **68**, whereby presence/absence of the ink can be detected.

[**0053**] An ink amount remaining in each of the color ink tanks **52**, **53**, **54**, **55** can be detected by passing the carriage **31** over the ink remain detecting sensor unit **56**.

[**0054**] **FIG. 4** is a flow chart showing an ink remain checking operation in the ink jet recording apparatus PR**1**, showing details of S**22** in **FIG. 5**.

[**0055**] A step S**1** initiates an ink remain checking operation. In a step S**2**, when the carriage **31** passes over the ink remain detecting sensor unit **56**, an optical remaining amount detection in the ink tank is executed by emitting an infrared light from the light-emitting element **67**, receiving the light from the light-emitting element **67** by the photosensor element **68**, thereby detecting an ink amount remaining in each color ink tank.

[**0056**] A step S**3** checks whether the ink is present in the liquid chamber **60**, and compares the result with the result of optical detection of the ink tank in S**2**. In case the ink is present in the liquid chamber **60**, the sequence proceeds to S**11**. In case the ink is absent in the liquid chamber **60**, a step S**4** checks an ink status. The sequence proceeds to S**7** unless the ink status indicates "ink present". In case the ink status is "ink present", a step S**5** changes the ink status to "ink low". Then a step S**6** starts a dot counting for ink error detection, and the sequence proceeds to S**15**.

[**0057**] A step S**4** checks the ink status, and, in case the ink status is not "ink present", a step S**7** checks whether the dot count for ink error started in S**6** has reached an ink error level. Then a step S**8** checks whether a no-ink timer has passed a predetermined time from a timing of a previous ink error. In case the predetermined time has not elapsed, the sequence returns to the main routine in S**15** and continues the process. In case the no-ink timer has passed the predetermined time, the sequence proceeds to S**9**.

[**0058**] In case the dot count in S**7** has reached the ink error level, the sequence proceeds to S**9** to shift the ink status to "ink error". Then a step S**10** stores the current time information, namely an ink error generation time information, in a non-volatile memory and executes an error notice and an error display, whereupon the sequence proceeds to S**15**.

[**0059**] The ink error generation time information, stored in the non-volatile memory, is maintained even when the power supply is turned off. The current time information is informed from the host to the no-ink timer, then renewed to latest information when the power supply is turned on, and is renewed thereafter in the printer.

[**0060**] In case S**3** identifies that the ink is present in the liquid chamber **60**, a step S**11** checks whether the ink status is "ink low" or an ink error. In case neither state is found, the sequence proceeds to S**15** to continue the process. On the other hand, in case the ink status is "ink low" or an ink error, it is identified that a tank replacement has been executed and a step S**14** changes the ink status to "ink present". Also a step S**13** stops the no-ink timer, then the step S**14** stops the dot count for ink error and the sequence proceeds to S**15**.

[**0061**] **FIG. 15** is a flow chart showing a ink tank checking operation of the ink jet recording apparatus PR**1**.

[**0062**] A step S**21** initiates an ink tank check. A step S**21** returns to S**1** in **FIG. 4** to execute an ink remain checking operation. Then a step S**23** checks whether the ink status is "ink error". If not an "ink error", the sequence proceeds to S**30** to clear a reset counter, and then proceeds to S**31**. In case the ink status is an "ink error", a step S**24** checks whether a tank replacement has been made. In case the tank replacement is identified, the sequence proceeds to S**30**. If not, a step S**25** checks whether a resume switch **4***b* has been depressed.

[**0063**] In case the resume switch **4***b* has not been depressed, the sequence returns to S**24** to continue the process. In case the resume switch **4***b* has been depressed, a step S**26** changes the ink status to "ink low". Then a step S**27** resets the dot count for ink error, a step S**28** executes an increment +1 of the reset counter, a step S**29** starts the no-ink timer, and a step S**31** terminates the ink tank check. A timer value set in S**29** may be determined from a table in the ROM **2** by referring to the reset count.

[0064] The table assigns a timer value for each reset count. For example, a smaller timer value is set for a larger reset count.

[0065] **FIG. 6** is a flow chart showing a printing operation in the ink jet recording apparatus PR**1**.

[0066] A step S**41** initiates a printing operation. A step S**42** executes a sheet feeding, and S**43** executes a printing. In the course of printing, a periodically interrupting handler S**50** measures dots of the ink used for printing (S**51**, S**52**). Upon completion of the printing in S**43**, a step S**44** executes a sheet discharge, then S**45** returns to S**1** in **FIG. 4** to execute an ink remain checking operation, and a step S**46** terminates the printing process.

[0067] **FIG. 7** is a flow chart showing a power-on operation in the ink jet recording apparatus PR**1**.

[0068] A step S**61** initiates a power-on procedure. A step S**62** clears the reset counter, and S**63** starts the no-ink timer. The set timer value may be determined from a table in the ROM **2** by referring to the reset count.

[0069] Since the reset counter is 0 in the power-on procedure, a particular value may be set at the top of the table, or the step S**63** is so constructed as not to start the timer.

[0070] A step S**64** activates a periodical handler. Then a step S**65** checks whether a print signal has arrived from the interface **20**. In case the print signal is not available, the operation of S**65** is repeated until the print signal arrives. In case the print signal is available, a step S**66** executes the printing, and the sequence returns to S**65** for continuing the process.

Second Embodiment

[0071] **FIG. 8** is a flow chart showing an ink remain checking operation II, constituting a second embodiment of the present invention, and providing a checking method in the absence of the mechanism for detecting the ink remain in the ink tank, in S**22** in **FIG. 5**.

[0072] A step S**71** initiates an ink remain checking operation. A step S**72** checks whether the no-ink timer has passed a predetermined time from the timing of a previous ink error generation. The sequence proceeds to S**78** if the predetermined time has elapsed. In case the predetermined time Y has not elapsed, a step S**73** checks whether the dot count is in an "ink low" level. If not, the sequence proceeds to S**81**. In case the "ink low" level has been reached, a step S**74** checks the ink status.

[0073] In case the ink status is not "ink present", the sequence proceeds to S**77**. In case the ink status is "ink present", a step S**76** sets a predetermined value X in the no-ink timer, and the sequence proceeds to S**84**.

[0074] A step S**74** checks the ink status, and, in case the ink status is not "ink present", a step S**77** checks whether the dot count has reached an ink error level. In case the ink error level has not been reached, the sequence proceeds to S**84**. In case the ink error level has been reached, a step S**78** changes the ink status to "ink error", and a step S**79** sets a predetermined value Y in the no-ink timer. Then a step S**10** stores the current time information, namely an ink error generation time information, in a non-volatile memory and executes an error notice and an error display, whereupon the sequence proceeds to S**84**. The ink error generation time information, stored in the non-volatile memory, is maintained even when the power supply is turned off.

[0075] In case the step S**73** identifies that the dot count is not in the "ink low" level, S**81** checks whether the ink status is "ink low" or an ink error. In case neither state is found, the sequence proceeds to S**84** to continue the process. On the other hand, in case the ink status is "ink low" or an ink error, a step S**82** changes the ink status to "ink present", and a step S**83** sets a predetermined value Z in the no-ink timer, whereupon the sequence proceeds to S**84**.

[0076] This application claims priority from Japanese Patent Application No. 2004-296765 filed on Oct. 8, 2004, which is hereby incorporated by reference herein.

What is claimed is:

1. An ink jet recording apparatus capable of controlling a no-ink error of an ink tank, the apparatus comprising:

measuring means which measures a consumed ink by a dot count;

detection means which detects absence of the ink in the ink tank;

first generation means which generates a no-ink error signal when the measuring means measures the consumed ink by the dot count and the detection means detects absence of the ink in the ink tank;

first canceling means which cancels the no-ink error signal by a replacement of the ink tank;

second canceling means which cancels the no-ink error signal without a replacement of the ink tank;

timer means which starts a timer in case of a cancellation by the second no-ink error signal canceling means; and

second generation means which causes the timer means to generate the no-ink error signal at a timing different from that of the first generation means.

2. An ink jet recording apparatus as claimed in claim 1, further comprising:

setting means which sets a time informed from a host in the timer means;

wherein the setting means generates the no-ink error signal.

3. An ink jet recording apparatus as claimed in claim 1, further comprising:

storage means which stores time information at which the no-ink error signal is canceled; and

comparator means which compares the time information stored by the storage means with a current time;

wherein the no-ink error signal is generated according to a result of comparison by the comparator means.

4. An ink jet recording apparatus as claimed in claim 1, wherein:

when the second canceling means cancels the no-ink error signal and starts the timer, a set value of the timer is changed according to a number of cancellation of the no-ink error signal.

5. A control method for an ink jet recording apparatus, comprising:

a measuring step of measuring a consumed ink by a dot count;

a first generation step of generating a no-ink error signal when the measuring step detects absence of the ink;

a first canceling step of canceling the no-ink error signal by a replacement of the ink tank;

a second canceling step of canceling the no-ink error signal without a replacement of the ink tank;

a timer step of starting a timer in case of a cancellation of the no-ink error signal by the second no-ink error signal canceling step; and

a second generation step of causing the timer step to generate said no-ink error signal at a timing different from that of the first generation step.

6. A control method for an ink jet recording apparatus as claimed in claim 5, further comprising:

a recognition step of recognizing a lapse of a predetermined time by a notice from a host;

an error generation step causing the recognition step to generates the no-ink error signal.

7. A control method for an ink jet recording apparatus, comprising:

a measuring step of measuring a consumed ink by a dot count;

a first generation step of generating a no-ink error signal when the measuring step detects absence of the ink;

a second generation step of generating the no-ink error signal at a timing different from that of the first no-ink error signal generation step and after a lapse of a predetermined time; and

a canceling step of canceling the no-ink error signal.

8. A control method for an ink jet recording apparatus, comprising:

a measuring step of measuring a consumed ink by a dot count;

a first generation step of generating a no-ink error signal when the measuring step detects absence of the ink;

a second generation step of generating the no-ink error signal at a timing different from that of the first generation step and after a lapse of a predetermined time;

a first canceling step of canceling the no-ink error signal by a replacement of the ink tank;

a second canceling step of canceling the no-ink error signal without a replacement of the ink tank;

a timer step of starting a timer of a second predetermined time in case of a cancellation by the second canceling step; and

a third generation step of generating the no-ink error signal by the timer step at a timing different from that of the second generation step.

9. A control method for an ink jet recording apparatus, comprising:

a first measuring step of measuring a consumed ink by a dot count;

a second measuring step of measuring a lapse of a predetermined time;

a generation step of generating a no-ink error signal, when the first measuring step measures the consumed ink by the dot count and the second measuring step measures the lapse of the predetermined time; and

a canceling step of canceling the no-ink error signal.

10. A control method for an ink jet recording apparatus, comprising:

a first measuring step of measuring a consumed ink by a dot count;

a second measuring step of measuring a lapse of a predetermined time;

a detection step of detecting absence of an ink in an ink tank;

a generation step of generating a no-ink error signal, when the first measuring step measures the consumed ink by the dot count, the second measuring step measures the lapse of the predetermined time and the detection step detects absence of the ink in the ink tank; and

a canceling step of canceling the no-ink error signal.

11. A control method for an ink jet recording apparatus, comprising:

a first measuring step of measuring a consumed ink by a dot count;

a second measuring step of measuring a lapse of a predetermined time;

a detection step of detecting absence of an ink in an ink tank;

a generation step of generating a no-ink error signal, when at least one condition among the first measuring step, the second measuring step and the detection step is satisfied; and

a canceling step of individually canceling the no-ink error signals.

12. An ink jet recording apparatus capable of controlling an ink remain amount in an ink tank, the apparatus comprising:

counting means which counts a discharged ink amount;

notification means which notifies a low ink remain amount when the count means counts a predetermined count value;

cancellation means which cancels the notification by the notification means; and

timer means which counts a predetermined time in response to the cancellation of the notification by the cancellation means;

wherein, in response to a counting of a predetermined time by the timer means, the notification means notifies a low ink remain amount before the count means counts a predetermined count value.

13. An ink jet recording apparatus as claimed in claim 12, further comprising:

storage means which stores time information at which the notification by the notification means is canceled by the cancellation means; and

comparator means which compares the time information stored by the storage means with a current time information;

wherein the notification means notifies a low ink remain amount according to a result of comparison by the comparator means.

14. An ink jet recording apparatus as claimed in claim 12, wherein:

when the counting of the predetermined time is initiated by the timer means, the predetermined time to be counted by the timer means is changed according to a number of notification by the notification means.

15. A control method for an ink jet recording apparatus, comprising:

a counting step of counting a discharged ink amount;

a timer step of counting a predetermined time;

a notification step of notifying a low ink remain amount in response to a counting of a predetermined time by the timer step before the counting step counts a predetermined ink amount.

16. A control method for an ink jet recording apparatus as claimed in claim 15, further comprising:

a cancellation step of canceling the notification of the low ink remain amount;

wherein, when the notification of the low ink remain amount is canceled by the cancellation step, the timer step starts a counting of a predetermined time.

17. A control method for an ink jet recording apparatus as claimed in claim 16, further comprising:

a changing step of changing the predetermined time, according to a number of cancellation by the cancellation step.

18. A control method for an ink jet recording apparatus, comprising:

a counting step of counting a discharged ink amount;

a storage step of storing time information;

a comparison step of comparing the time information stored in the storage step with a current time; and

a notification step of notifying a low ink remain amount according to a result of comparison by the comparison step, before the counting step counts a predetermined ink amount.

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